

Fun is not enough – The role of Universities in encouraging middle school students to consider technical careers.

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Introduction: The University of New Mexico PACE program is entitled “Space Science for New Mexico MESA students”, and has the goal of educating middle school students about space science, and interesting them in pursuing technical careers. The participating students are enrolled in New Mexico Math, Engineering, and Science Achievement (MESA) classes, which are offered in minority-based schools throughout New Mexico. The program consists of several visits by graduate students and faculty members to minority dominated MESA classrooms for activities, a field trip (Figure 1), and a follow-up visit to the classroom. Our original goal was to enhance the space science content for middle school students. However, it became apparent to us that we must consider the attitudes of students as well as content. Therefore, as part of this project graduate students Carmen Sorge of the UNM College of Education, Justin Hagerty of the Institute of Meteoritics, and I surveyed several hundred largely Hispanic student participants using scientific methods, and obtained results regarding the barriers to students attitudes about pursuing a technical career (Sorge et al., 2000). As a result, we are now directly addressing the misconceptions and the lack of knowledge that most of these students have about college and about pursuing a career in Math, Science, Engineering, and Technology (MSET). We believe that addressing these issues with both students and parents should be an important part of the K-12 experience.



Figure 1. Middle school students can run an electron microscope!

Assessment: In order to better understand the attitudes and misconceptions of our target population, we have designed an instrument to measure student attitudes toward science and scientists, which is administered before and after our program. This instrument has a reliability of 0.73 and has been given to over 300 students. To supplement these surveys, we have collected student questions about college and have conducted interviews with the participating teachers. These efforts have allowed us to examine the overall changes in attitude and the more subtle effects related to individual questions. While attitudes toward science improved after our program, we found other surprising results. For example we have found that although 76% of the students agree that “It would be fun to work in a science laboratory,” only 30% indicate that they would like to be a scientist. Clearly, stereotypes about science and scientists can drastically effect student

attitudes about science in general, since most students do not think that they could become scientists or engineers themselves.

Results: The results from these surveys suggest that there are several misconceptions that can prevent qualified students from pursuing an MSET academic program either in high school or in college.

- Math and science ability – Nearly half (46%) of the students are convinced that only geniuses can pursue an MSET career. Less than a third realize that it is normal to sometimes struggle with math and science concepts.
- The nerd factor – Students are strongly influenced by the media stereotype of scientists as brainy, absentminded, unkempt, and wild-haired eccentrics. Forty percent of the students indicated that they do not know any real scientists or engineers.
- Financial implications – Less than half of middle school students realize that MSET college students can have an income obtained primarily through scholarships and research jobs. Another disturbing result was a different survey of both middle and high school MESA participants that showed many students are worried about paying for college. These students also do not realize that a college degree significantly increases their earning potential.
- Career opportunities – In addition, the survey found that <35 % agree or strongly agree: “I could be a scientist if I wanted to”. Yet >50 % agree or strongly agree: “I could be a professional athlete if I wanted to”! Because there are roughly 1,000 times more technical jobs in the United States (four million) than professional athletes (3,500), these students do not have a good understanding of their opportunities.

Our surveys found that students unanimously agree that scientists can be of any race or gender, even if they do not personally believe that they could become a scientist. Students understand in theory that a career in science and technology is possible but they do not consider it for themselves. We believe that the informational barriers discussed above are harder for minority and low-income students to penetrate because of the lack of exposure to scientists, and especially minority role models in MSET careers. The ideal situation would be to give every secondary student a chance to work for some time with an MSET professional, but this is not practical. Hopefully, proactive measures, such as the ones discussed below, will partially substitute for the direct contact with an MSET professional.

Addressing the misconceptions: In order to address the issues described above, we have taken several steps to modify our outreach program. The main portion of our program continues to consist of space science related activities, including building a comet, producing small scale impact craters, and studying a mystery “meteorite” with magnifying glasses and with the Scanning Electron Microscope. These activities are accompanied with short slide shows. To this mix, we are currently emphasizing the following points in our program, which make up a small, but very important part of our outreach program:

- It is normal to struggle at times, and help is available.
- Being brilliant at math is helpful, but is not required.
- Scientists are normal people.
- Technical careers are financially rewarding.
- College scholarships and student employment are available to most students.
- College students in science and technology fields (undergraduate and graduate) are well paid in jobs related to their interests.

Some of the specific techniques that scientists and engineers can use to communicate these ideas during outreach programs include the following:

- Establish your credibility by taking the time to present yourself as a person to the students. For example, discuss your personal background, including your hobbies, your family, and your school experiences.
- Directly address personal difficulties with math and science. This serves to show the students that not all scientists are Einsteins! It may also be beneficial to discuss the financial aspects associated with college life.
- Conduct activities to demonstrate the relative chances of succeeding in professional sports versus an MSET-based career. For instance, we have created an activity that concretely relates the chances of becoming a scientist, to the chances of becoming a professional athlete. We also discuss the financial rewards of finishing a college degree in terms of lifetime pay.

- Reinforce your message by introducing the students to peer college students and faculty members. Secondary students identify most easily with college students, who can relate to the younger students backgrounds and interests.
- Include a time for students to ask questions about college. Many students are too shy to ask the questions that they really want to know about; therefore, having the teacher collect questions the day before the program can be very effective.
- Provide materials to teachers for use before and after the presentation. For example, many universities can provide brochures or video tapes about college life and financial information. Information concerning education requirements should be provided, including the kinds of science and math classes students should take in High School.
- Discuss these issues with teachers and parents during appropriate opportunities, such as workshops or open house events. While programs with college students from peer groups have a lot of credibility with the secondary students, the students need to be reminded on a regular basis by their teachers and parents that they can consider an MSET career.
- Include information about student attitudes in teacher training programs.

Conclusions: As our outreach program evolves, we increasingly find that encouraging students to consider technical careers requires more than just providing space science content. Students and their parents are excited about space science, but are uninformed about the benefits of pursuing a technical career compared to other careers. They are also uninformed about the necessary preparation in High School, such as the benefits of taking hard courses, even at the expense of a perfect grade point average, and the requirements and opportunities for pursuing a technical career in college. Many misconceptions that secondary students have about science and scientists can be directly addressed during programs already being offered by universities, NASA facilities, and engineering and scientific organizations. The gap that exists between minority secondary students enthusiasm about science and their potential accomplishments can be bridged with the help of professional and academic role models, especially from minority or peer groups, who are trained to address the issues.

Therefore, the essential components for encouraging students to consider a technical career, and to overcome common misconceptions includes making sure that both teachers and students understand the message - *All students can earn scholarships and pay for college, math can be learned, working in science is fun and well paid, scientists and engineers are people like you!*, Also important is providing university, laboratory, and industry programs that validate the message and share the excitement.

Reference: Sorge, C., Newsom, H.E. and Hagerty, J.J. (2000) Fun is not enough - Attitudes of Hispanic middle school students toward science and scientists, *Hispanic Journal of Behavioral Sciences*, 22, 332-345.